

THE
BELGIAN ANTARCTIC EXPEDITION

UNDER THE COMMAND OF

A. DE GERLACHE DE GOMERY

SUMMARY REPORT

OF THE

VOYAGE OF THE "BELGICA,"

IN 1897-1898-1899



BRUSSELS

HAYEZ, PRINTER TO THE ROYAL ACADEMY OF BELGIUM

Rue de Louvain, 112

1904

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THE FIRST WINTERING IN THE ANTARCTIC. — THE « BELGICA » IN 1898.

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THE BELGIAN ANTARCTIC EXPEDITION

The Belgian Antarctic Expedition owes its initiative to the enterprise of M. Adrien de Gerlache de Gomery, lieutenant in the Belgian navy, who, on the completion of its organisation, also assumed the command. As early as the beginning of 1894, M. de Gerlache communicated to M. Du Fief, secretary to the Geographical Society of Belgium, his scheme of a Belgian expedition to the South Polar regions. The project called forth an enthusiastic response from the Geographical Society and was soon crowned with the patronage of H. R. H. Prince Albert of Belgium. A subscription list inaugurated by the Geographical Society became promptly graced by the names of many generous donors. Among the more strenuous supporters of the venture may be named Lieut.-General Brialmont, MM. Delaite, Du Fief, Léo Errera, Houzeau de Lehaie, Charles and Eugène Lagrange, Lancaster, Commandant Lemaire, MM. Pelseneer, Renard, Ernest Solvay, Count Hippolyte d'Ursel, Van Beneden, Mesdames de Rongé and Osterrieth.

Gift of P. C. 1110.

The amount collected by private subscription fell, however, short of the requirement. M. Schollaert, Minister of the Interior and Education, accordingly laid before parliament a bill for a grant of 160,000 francs (£6,400). A credit to this amount, deemed sufficient for the equipment and victualling of the vessel, was unanimously voted by the Chamber of Representatives and the Senate. The total cost of the expedition did not reach £20,000. This sum, however, does not include the expenditure involved in the publication of the scientific results, an item alone amounting to £10,800.

MEMBERS OF THE EXPEDITION

1. OFFICERS :

Adrien de Gerlache, commander.

Georges Lecointe, second in command, executive officer and hydrographer. On the death of Lieutenant Danco, he took over the duties of magnetician.

Henryk Arctowski, geologist, oceanographer and meteorologist.

Frederick A. Cook, surgeon, photographer and anthropologist.

Emile Danco, magnetician. He died 5 June 1898.

Antoine Dobrowolski, assistant meteorologist.

Emile Georges Racovitza, naturalist.

Roald Amundsen, first mate.

Jules Mélaerts, second mate.

2. ENGINEERS :

Henry Somers, chief, and Max Van Rysselberghe,
second engineer.

3. CREW :

Tollefsen, boatswain; Michotte, steward; Johansen
and Knudsen, seamen; Dufour, Van Mierlo,
Wiencke and Koren, ordinary seamen.

More sailors had been engaged, but for various reasons, chiefly insubordination, it was found necessary to discharge them. There might have been some misgivings about launching into the Antarctic with so very limited a crew. The season, however, was too far advanced to allow of our awaiting at Punta Arenas the arrival of fresh hands which were not to be had in Magellan Straits. Rather than loiter another year on the brink of the adventure, the expedition resolved to trust to their good fortune to supply any defect of equipment.

PLAN OF THE EXPEDITION

The original plan was to make Punta Arenas the base of operations and, sailing thence, arrive, in the beginning of the austral summer, within the antarctic circle below South America, thence, hugging the icefield in an easterly or westerly direction, make for Victoria

Land and there, at Cape Adare, leave four members of the expedition to pass the antarctic winter. The ship then to proceed to Australia for revictualling at Melbourne, and, after making a cruise of the Pacific, to return, the following spring, to take up again the little group of explorers at Cape Adare.

In consequence, however, of a succession of delays in the progress of the expedition and in view of the smallness of the crew, it was at last found necessary to change the plan. The programme was adjusted as follows :

To make for the South Shetlands, holding as near as possible by the meridian of St. John (Staten Island), make the passage of Bransfield strait and explore Hughes Bay. There to investigate, in particular, whether there was not a channel leading from the south of this bay to the east coast of Graham Land, either direct or by way of Bismarck Strait °. Should such a channel be found, to make a tentative exploration of King George's Sea †. Thence to return to winter in South America and there replenish the commissariat and complete the crew. The following year, if the results of the previous reconnaissance invited, to make again

° This strait, according to Dallmann, runs from east to west, cutting through Graham Land on the north, its western opening being situated at about 65°10' S. lat.

† In 1823, Weddell found this sea clear of ice to beyond the parallel of 74°25'.

for King George's Sea, but, in the contrary event, to hug the icefield eastwards or westwards, taking Ross's Sea as base of operations. The undertaking to be then prosecuted according to the plan first determined on. De Gerlache, Amundsen, Danco, and Arctowski or Racovitza to winter in Victoria Land. Lecointe to pilot the "Belgica" to Melbourne and there revictual. The season, closed for Antarctic operations, to be turned to account by Lecointe in making a voyage in the Pacific Ocean, it being open to him to choose his own course and be guided by circumstances. The following summer the Belgica to go and pick up again the explorers at Victoria Land. The reunited staff to then continue the researches already begun. On the approach of the next winter the expedition to return to Europe.

The scientific work of the expedition was to include the following branches : — astronomy, terrestrial magnetism, pendulum measurements, geography, hydrography, meteorology, geology, oceanography, zoology, botany and anthropology.

THE BELGICA

Originally a Norwegian whaler and christened *Patria*, the Belgica is a vessel of 244 tons, 110 feet long by 26 feet beam. She was thoroughly overhauled and put in perfect trim for the purpose of the expedition. Her hull is of the hardest Norwegian timber. It was streng-

tened by an outer sheathing of greenheart covering its whole length almost up to the sheer-rail and protecting the hull against the friction of ice.

A number of iron bands lent increased resistance to the stem.

Towards the stern-post two wells communicated between the deck and the sea. One of these wells, the helm-port, serving by way of passage to the upper portion of the main piece of the rudder, allowed, in case of damage, a readier replacement of the latter. The other was utilised for lifting the propeller, protecting it from ice, or for facilitating progress under sail.

The Belgica had a double-bladed propeller of narrow width so that, placed vertically when the ship was under sail, it was in larger part hidden by the stern-post.

The double expansion engine was nominally of 35 H. P. At full steam of 115 revolutions the Belgica made 7 knots an hour; at medium steam, 4; and, when reduced to the minimum consumption of no more than 1.8 tons a day, 3. Her boiler was completely new.

The rest of the machinery of the Belgica comprised a distiller for the conversion of sea into fresh water, which, particularly well adapted for its purpose, proved of the greatest service in the icefield; a powerful windlass for lifting the drag-nets and available, in contingencies, for other operations; a machine for winding up the drag-net chain, a model of its kind, from the Copen-

hagen arsenal; and, lastly, a Le Blanc sounding machine.

The Belgica was rigged as a three masted barque, but having its topsails provided with pulleys.

In the way of living rooms, there were the cabins under the poop for the members of the staff; the laboratory under the bridge; and in the fore part, between decks, the fore-castle for the crew.

Seeing the ceiling and bulkheads aft were double, a thick coating of felt was inserted between the double walls, the better to husband the heat in this part of the ship.

The fore-castle for the crew was spacious, well ventilated and lighted by a large skylight. It contained sixteen berths, supplied with good mattresses and warm woollen blankets.

The laboratory erected on deck was lighted by two large windows and five broad portholes. It was partitioned off longitudinally into two compartments, the starboard compartment occupied by M. Racovitza and the portside by M. Arctowski.

SCIENTIFIC APPARATUS

1. *Navigation and Hydrography.* — Three large chronometers and a deck watch; a Hurlimann's sextant with double refracting prism and night-glass (Fleuriais); a liquid artificial horizon; a glass artificial horizon;

a protractor and metallic rulers; a field theodolite; a Thomson's standard compass; a liquid compass; and a series of boat compasses.

2. *Magnetism*. — A magnetic theodolite and a Brunner's inclinometer; a Neumayer's magnetometer; and a von Steerneck pendulum.

3. *Meteorology*. — A marine barometer; a large and a small aneroid; a meteorological screen erected on the bridge; six sling thermometers; two pairs of psychrometers with mountings; six alcohol thermometers with centimetrical graduation; a toluene thermometer for low temperatures; two pairs of Arago actinometers; a sunshine recorder; a Mohn's anemometer; a Dines's anemometer for measuring strength of wind; three earth thermometers; a cloud atlas; an Alluard hygrometer; weekly registers, all Richard's system, viz. a barometer, a hygrometer, a thermometer, and a psychrometer; a daily registering barometer and thermometer, Richard's system; various meteorological works and tables.

4. *Oceanography*. — A Le Blanc sounding machine; a Belloc sounding machine (small machine for sounding from a boat); a steel wire and sounding line; three sounding-leads, Prince of Monaco's principle; sounding-lead with cup, constructed by Chabaud according to M. Arctowski's instructions; three sounding-leads, modified Sygsbee's system; a new sounding-lead fash-

ioned in the Antarctic according to M. Arctowski's instructions; three Sygsbee bottles; a Buchanan bottle; two Buchanan densimeters; an Abbe refractometer; two Secchi discs (not used); wide-necked flasks for storing specimens of sediments; flasks for keeping in the laboratory specimens of sea-water brought up while taking soundings; two buckets for drawing surface water; two thermometers graduated to $\frac{1}{10}$ of a degree for measuring the temperature of surface waters, and thermometer mountings; Negretti and Zambra and Chabaud thermometers for measuring temperatures in deep water, and thermometer mountings; Rung's verniers; Forel und Ule scales; two normal thermometers (for comparison); a gauge mounted à la Cardan for measuring the density of waters; apparatus for distilling small quantities of water and a large flagon for keeping distilled water in the laboratory.

5. *Geology*. — A portable plummet, Van den Broeck system; a microscope; a blow-pipe and reagents for blow-pipe supplied by the mineralogical laboratory of Ghent university; reagents and every requisite apparatus for making qualitative chemical analyses; two hammers; two ice-axes; a pickaxe; two knapsacks for holding specimens; a quantity of canvas bags for storing sand, etc.; a compass; a photographic apparatus; an altimetric aneroid barometer; a hypsometer; a Fortin barometer (small size).

6. *Zoology and Botany*. — In the way of dredging

gear, four trawl-nets, Sygsbee principle, 5 and 7 feet wide at the mouth; a small trawl-net made on board the *Belgica* while wintering, which was available for fishing through a hole bored in the icefield; two iron framed dredges, with tangles. The fishing apparatus included a drag-net, a variety of lines and hooks, eel-traps, iron and wicker bow-nets. For pelagic fishing there were three fine silk-nets with filtering bucket; two nets for fishing when the ship was at full speed, Buchet principle; two closing-nets for deep sea fishing, Giesbrecht principle. There was a supply also of hoop-nets and landing-nets, hand-harpoons, hooks, etc. Also two harpoon guns for fishing hyperoodons; hunting rifles, and double barrel guns.

There were, moreover, a steam windlass for the dredging machines, with a steam barrel carrying 3,250 fathoms of steel cable, and a derrick with dynamometer.

The laboratory was amply furnished with microscopes, lenses and dissecting instruments, a variety of reagents, 330 gallons of alcohol, glass jars and tubes, zinc cases, etc. Also a botanical press and blotting paper for drying the plants.

7. *Books.* — The library was stocked with works on the Antarctic regions; nautical directions in French and English; French books on lighthouses; and the English admiralty charts.

COAL, CLOTHING, PROVISIONS AND ICE-APPARATUS

At Antwerp the Belgica shipped 120 tons of briquettes of compressed coal and 40 tons anthracite for consumption in stoves on board ship and in the wintering huts. A hundred tons of briquettes were also despatched to Punta Arenas, which was to serve as the base of operations.

The amount of oil for greasing purposes, oakum, implements of navigation, sail-cloth in reserve, carpenter's tools and materials had all been reduced to a strict minimum.

A special outfit had been provided for the four persons assigned to the winter station. It comprised a fur suit to each of them and woollen clothing of a particular quality. The materials for the winter encampment included two wooden sheds, two sledges, a tent, skis, snow-shoes, "Finshoes" °, "Koemakers" °, felt boots and two small heaters, one of them of the pattern used by Jackson.

Besides the special outfit above noted, there was a particular dress provided for the other members of the expedition, in case they too might have to winter in the Antarctic. The whole, however, made up a wardrobe of but modest compass.

° Norwegian boots.

The question of provisions had been very carefully thought out.

The Belgica took with her about 10 cwt. of tonite for blasting blocks of ice dangerous to approach or blocking the passage to open water. Firing was to be done by means of the Bickford match and fulminate of mercury caps of which there was a plentiful supply on board.

In addition, the Belgica had four large ice-saws which proved of invaluable service. They opened the holes for sounding and fishing, and it was by their means that the expedition was at last able to deliver the ship from its ice-imprisonment in 1899.

CROSSING THE ATLANTIC

On sixteenth August 1897, amid lively demonstrations of enthusiasm from the citizens, the Belgica steamed out of the port of Antwerp. She was escorted on her departure by a flotilla of yachts and a Government ship carrying on board the Minister of the Interior and Education. At the border line of the Dutch waters she was saluted by the firing of twenty one guns from the ironclad Kortenaar, graciously despatched to meet her by H. M. the Queen of the Netherlands.

The Belgica first repaired to Ostend to complete her principal preparations. Here, while mooring for eight days, she was visited by H. M. King Leopold II, who

took a warm interest in the mission of the expedition.

On August 23, the ship was fairly bound on her voyage. After calling successively at the ports of Funchal (Madeira), Rio de Janeiro and Montevideo, the Belgica, on December 1, cast anchor in the harbour of Punta Arenas. At each of the above ports of call the chronometers were regulated and the principal instruments adjusted and compared.

The long passage across the Atlantic Ocean was turned to account by the members of the Expedition in perfecting the scientific arrangements, adjusting the respective services, and instituting meteorological and oceanographical observations.

From December 14, 1897 to January 14, 1898, the Belgica navigated the channels of Tierra del Fuego, and its officers landed at numerous points to make geographical, geological and ethnographical observations and to collect specimens of fauna and flora.

The following are the ports of call and the places visited by the Expedition in the channels of Tierra del Fuego : —

Mac Donald Station, Morro Chico, Cabo del Monte, Farmer's Galpon, Cape Gregory, Ste. Elizabeth Island, Punta Arenas, Chabunco, Rio de las Minas, Punta Carrera, Port Famine, Harris Bay, Havre Hope, Basket Island, Torrent Bay, Great Glacier Bay, Asterias Bay, Lapataia, Acigami Lake, Ushuaia, Harberton Harbour, Rabbit Island, Porto Toro, St. John's harbour.

SOUTH OF CAPE HORN

Leaving Staten Island on January 14, 1898, the *Belgica* steered a course southwards to Graham Land.

On January 21, making her way through a dense fog, she arrived in front of Livingstone Island.

During this passage the Expedition traced out an important line of soundings from which they were able to determine the bathymetric profile from Staten Island to Rugged Island, which lies close to Livingstone Island. This profile shows the ocean-floor to be of the shape of a flat bottomed basin rising gently towards the Shetland Islands. In front of each of these islands the continental plateau projecting forms a very narrow rim, beyond which the land again falls away very abruptly.

Measurements of the temperatures of the sea water proved : 1st, That at the same depth the heat diminishes as one approaches the South Shetlands; 2nd, That a layer of icy water flows between two layers of warmer water and increases in thickness as the distance to the Shetland Islands lessens.

GERLACHE STRAIT

On January 22, the vessel was caught in a storm in Bransfield Strait. To free a stopped scupper, the sailor Wiencke rashly suspended himself outside the

bulwarks, and was washed overboard. All the attempts to save his life were unavailing.

On January 23, the Expedition discovered a new Strait which, on the return of the Expedition, was named De Gerlache Strait. From January 23, to February 12, was devoted to its rapid survey. The scientific staff landed at twenty different points and made an important collection of zoological, botanical and geological specimens. On one of these landings several members of the Expedition attempted the ascent of the Solvay mountains. The elements of terrestrial magnetism were determined in a number of places in the Strait. Meteorological observations were systematically carried out. A sounding was obtained which gave a depth of 340 fathoms.

HYDROGRAPHY OF GERLACHE STRAIT

To accomplish in twenty days the survey of an area so spacious recourse was had to the most expeditious methods. The geographical co-ordinates of a certain number of notable points on the coast were ascertained by astronomical observations; those of other points by taking bearings of the land from the Ship.

Numerous photographs taken in the straits were also serviceable for the purpose of drawing a map of it.

Gerlache Strait is confined between 63° 55' and 65° S. lat. and between 61° and 64° W. long. Stretching in a NE-SW direction, it has an air-line length of about

a hundred miles. On the NW, the Strait borders on an archipelago of numerous islands, among which the Expedition took bearings of the eastern shores of the islands Liege, Brabant and Antwerp. Between Brabant and Antwerp, again, the channel was named Schollaert Strait, and from it was perceived in the distance the island of Gand. Along the SE of the Strait stretches Danco Land. In the Strait itself numerous islands lie scattered, the most important being Wiencke Island. This last is cut off from Antwerp Island by Neumayer Strait. Between the other islands and Danco Land run channels broader or narrower.

TERRESTRIAL MAGNETISM IN GERLACHE STRAIT

In various places on the coast local disturbances of a certain importance were observed. Taking into account, however, the geological constitution of the soil and the position of the places, in which perforce the measurements had to be made, there was nothing abnormal in the phenomena.

GEOLOGY OF GERLACHE STRAIT

At the different landings important geological collections were made. Sedimentary strata were found only in two places. At the thirteenth landing a steep cliff in the Sophia Rocks was found to be composed of strata of

arkose, schists, and a metamorphic breccia in contact with a massif of pegmatite. Next, on a small island (8th landing) some strata of speckled schist were found alternating with intrusive melaphyre.

Everywhere else the rocks in position were eruptive rocks of the ancient formation — diabase, quartziferous diorite, diallage, gabbro, porphyrite, melaphyre and varieties of granite. In different places were found masses of erratic blocks accumulated in the shape of ancient terminal as also of ancient lateral moraines, indisputable vestiges of the glacial age. There was a very copious variety of erratic rocks — gneiss, mica-schist, quartzite, sandstone, etc.; syenite, andesite, porphyries, breccia and volcanic tufa, basalt, etc. During the pleistocene period Hughes Bay was completely flooded by an immense outflow of the inland ice. De Gerlache Strait and Flanders Bay served as a drainage bed to the rivers of ice which, in all likelihood, terminated beyond the present coasts of the Palmer Archipelago.

In these times there is still going on a glaciation, no less intense, a few degrees further south, in the region of Alexander Land. The present glaciers of the lands discovered by the Belgian Antarctic Expedition are of the most imposing character.

In Hughes Bay the line of perpetual snow reaches to from 100 to 130 feet above sea level. In Flanders Bay it is level with the sea itself. Nearly everywhere walls of glacier snow (*névé*), 60 to 100 feet high, overhang the

shores. Otherwise the glaciers end in cascades of ice or extend into the heads of bays, giving birth to icebergs. Nowhere is the clean face of the ice of the glacier to be seen. The antarctic glaciers have the appearance of the fields of névé of Alpine glaciers. In the interior of Danco and Graham Land the inland ice has levelled all inequalities of landscape. From the Solvay Mountains, which command a wide horizon, the eye sweeps eastwards and southwards over one unvaried plain.

The icebergs formed from antarctic glaciers are mostly of tabular shape.

METEOROLOGY OF GERLACHE STRAIT

Meteorological observations were carried out regularly on board the *Belgica* throughout the whole voyage from the time of departure from Staten Island. The lowest temperature obtained from January 23 to February 14, 1898, was -2.5° C. (27.5° F.); the highest, 9.6° C. (49.28° F.). Generally, however, the temperature stood between 0° and 3° C. (32° and 37.4° F.). The weather, often calm, was always uncertain, the wind rising sometimes abruptly. The sky was seldom clear and fogs were frequent.

FAUNA AND FLORA OF GERLACHE STRAIT

Among the specimens brought home by the Expedition, mention must be made of a Diptera (*Belgica*

antarctica n. g. n. sp.), three snow Spring-tails (*Achortoides antarcticus* n. g. n. sp., *Cryptopygus antarcticus* n. g. n. sp., and *Isotoma sexoculata* n. sp.) and five new species of Mites. These are the first land animals discovered in the Antarctic. The microscopic animals included Infusoria (slipper-animalcules), Rotifera (wheel-animalcules), Nematoda (round- or thread-worms), and Tardigrada (water-bears or sloth-animalcules); all living in fresh water supplied by the melting of the snow and among some species of microscopical fresh-water plants.

The rocks lining the shores, continually subjected as they are to the action of the ice, offer no asylum to the shore-animals. Sea-weed was very seldom met with in the region visited by the Expedition. Only in sheltered spots were found dwarfish sea-weeds on which lived some species of marine animals.

The perpendicular walls of rocks, as they do not retain the snow, are here and there covered with Lichens, of which as many as 55 species were counted. In damp places, also, Mosses, comprising 27 species, most of them new, were found growing. In certain sheltered sites were discovered tufts of a Grass (*Aira antarctica*), the only flowering plant living in these latitudes.

In the way of Birds, numerous Cormorants frequent the Strait. Among the Gulls are the Black-backed gull (*Larus dominicanus*), brown Skua (*Megalestris antarcticus*), and Terns. Petrels are equally represented, such as the Cape pigeon (*Daption capensis*), snowy Petrel

(*Pagodroma nivea*), and giant Petrel (*Ossifraga gigantea*). All these birds build along the shores of the Strait. Nor must be forgotten the wattled Sheathbill (*Chionis alba*), the only unwebbed bird of the region. It was seen but once, namely in Augustus Island where it hides its nest in a natural grotto.

Two species of Penguin were met with : the Stone-cracker (*Pygoscelis antarctica*) and the Johnnie (*Pygoscelis papua*). These live in rookeries, the highly interesting organisation of which M. Racovitza made the subject of his zealous investigation.

The Expedition found two varieties of seal in de Gerlache Strait ; the Weddell seal (*Leptonychotes Weddellii*) and the Crab-eating seal (*Lobodon carcinophaga*).

Cetacea abound. Rorquals (*Balaenoptera*) and Humpbacks (*Megaptera*) are numerously represented. No Right Whales (*Balaenae*), however, were seen.

LANDINGS IN GERLACHE STRAIT

LANDINGS.	WHEN.	WHERE.
	1898.	
I.	23 rd January.	Augustus Island.
II.	24 th January.	Moreno Island
III.	25 th January.	Islets to the N. of Harry Island.
IV.	25 th January.	Harry Island.
V.	25 th January.	Cape Neyt (N. E. of Liège Island).
VI.	26 th January.	Two Hummock Island.
VII.	27 th January.	Cobalescou Island (S. of Two Hummock Island.

LANDINGS.	WHEN.	WHERE.
VIII.	28 th January.	Gaston Islet (Charlotte Bay.)
IX.	29 th January.	Cape Anna (N. W. of Wilhelmina Bay, Danco Land).
X.	30 th January to 7 th February.	Cape Ursel (S. of Buls Bay, Brabant Island).
XI.	1 st February.	Cape Van Beneden (N. of Andvord Bay, Danco Land).
XII.	2 nd February.	Cavelier de Cuverville Island (N. of Errera Strait).
XIII.	7 th February.	Sophia Rocks (S. of Wilhelmina Bay, Danco Land).
XIV.	8 th February.	Antwerp Island.
XV.	9 th February.	Wiencke Island (S. of Neumayer Strait).
XVI.	9 th February.	Easternmost island of the Wauwermans Archipelago (Pacific Ocean).
XVII.	9 th February.	Isle of Bob (East Coast of Wiencke Island).
XVIII.	10 th February.	Banck Island (S. of Bryde Island off Danco Land).
XIX.	11 th February.	Westernmost Isle of the Moureaux Islands (Flanders Bay).
XX.	12 th February.	South of Cape Renard (Danco Land, near Lemaire channel).

ALEXANDER LAND

On February 12, 1898, the Belgica steered out of Gerlache Strait and, almost immediately afterwards, struck, for the first time, on sea-ice. Next day she was nearly all morning, in view of Cape de Trooz, labouring in the floating ice, through which she tried in vain to force a passage eastwards. But hindered by the density of the pack she was obliged to make again for the northern edge of the icfield. From February 15 the ship

continued, enveloped in fog, and directed her course so as to leave the border of the icefield on her port side. The sky day after day continued to show steady iceblink. On February 16, during a transient clearing, the Expedition sighted Alexander Land. An astronomical observation fixed the position of the ship, and, by taking bearings, an idea could be formed of the three most salient points on the coast. Alexander Land was seen only afar off, and it was impossible to even approximately measure the distance between its coast and the ship.

Two capes, C and D, were first seen to emerge. Near



point A is situated the massif L. This latter seems to be isolated but may possibly communicate with the neighbouring lands by a low-lying isthmus under our visual horizon. At M there shoot up three white hillocks.

They are icebergs or islands similar to those observed at various places in Gerlache Strait. Or perhaps they are a continuation of the contour C D B A with which these heights are possibly connected by an isthmus out of sight. East of B, the retiring land forms a gulf. Parallel to the coast, L B D, runs a chain of mountains, the arête of which, sharp and slim, detaches itself distinctly from the principal mass. So marked indeed is the relief of this arête as to suggest the question whether this chain be not part of an island situated on this side of the land, A B C.

Near cape D the chain of mountains is notched like the teeth of a saw. In the interior, in the region E, the ground, of gentle slope, looks like a gigantic glacier inclining seawards between the points B and D. There are two notable chains, F and G, running parallel to one another. The chain G slopes gently towards the sea. The crest, F, falls away in snowy hummocks, also losing themselves in the ocean at I. At H, however, a characteristic spur branches off, limiting apparently, on the west, the glacier E.

The region K is comparatively low, only showing here and there a few hummocks of little elevation.

At C, again, there is a series of hummocks of no special bearing, but connected in various ways with the chain G and with the coast.

In front of Alexander Land are numerous icebergs but not of the characteristic tabular form. Some, of complicated architecture, have a bizarre appearance;

others look like the spire of a cathedral. On account of the density of the icefield it was impossible to approach the land. The border of the icefield ran E-W, and was formed of small fragments of icebergs and sea-ice. In the hope of finding a clearing further W, the Expedition skirted the icefield in that direction and, on February 18, attempted a second time to force a passage. After making but a few miles southwards, the Belgica was held fast, and saw her way to the open sea completely closed. In the evening about 8-30, the ice slightly yielded, and with prodigious effort the ship regained the edge of the icefield.

On February 20, a third attempt was made to force a passage, a project which the Expedition was again obliged to abandon. Yet, in the south, the sky gave reflections of open water. On February 23, one more effort was made to force a way through the icefield. This time, too, the efforts were foiled. The season being now too advanced, it was necessary to retreat northwards.

On February 28, an unforeseen occurrence suddenly opened for us a new path. A tempest arose and set the whole icefield in commotion. The ice broke up and gave way. The wind blowing E by N, the course out of the icefield was perfectly clear to us to the N and the W.

Here was an opportunity not to be missed. Turning her head southwards, the Belgica plunged deeply into the pack, making some ninety miles further south.

FIRST WINTERING IN SOUTH-POLAR ICE

The ice torn open by the tempest closed again on the March 2, and it was only with the most strenuous exertions that the vessel made two miles more southward.

The temperature soon fell, especially during the night, and new ice, formed in the interstices, again joined together the parted icefields. On March 3, the Expedition tried in vain to extricate itself northwards, but the compact ice was not to be breached. Finally, on March 5, the *Belgica* was compelled to accept the position of prisoner in the ice. The staff therefore set about making preparations for their winter quarters.

* * *

In the early days of March 1898, the ship drifted in the imprisoning ice southwards. On March 15, the drift stopped. The movement had been caused by the storm blowing continuously the previous days.

The Expedition set up two observatories on the ice; one for magnetic, the other for astronomical observations. To avoid removing the chronometers across the ice, where they would inevitably have suffered injury, the astronomical observatory was put in communication with the *Belgica* by means of a telegraph wire. The boiler being no longer under pressure, a hand-windlass was erected on the ice to be used for soundings and measurements of submarine temperatures.

On May 17, 1898, the Sun disappeared till July 22, giving us a night of over 1,600 hours duration. Soon after the Sun's disappearance, Lieut. Danco died of heart disease. His body was committed to the sea on June 7, 1898.

Little by little the members of the Expedition became, body and soul, affected with languor. Each one continued to do his duty, but did it painfully. Polar anemia preyed on almost every one. In some the number of pulsations mounted to 150 per minute: in one the number fell to 47. The want of fresh food was sorely felt. Officers and crew began to eat penguin and sealmeat. In the middle of winter, Commandant Gerlache, Lieut. Melaerts, and the steward, Michotte, all showed symptoms of scurvy.

One sailor had fits of hysteria which bereft him of reason. Another, witnessing the pressure of the ice, was smitten with terror and went mad at the spectacle of the weird-sublime and in dread of pursuing fate.

In spite of these painful incidents, the scientific work went on without interruption, in a climate much more trying than that of the North-Polar regions. Here the air is perpetually charged with moisture, the sky continually wrapped in dense mist, storms of exceptional violence constantly blowing.

In July 1898, the Sun re-emerged, and with the returned Sun hope sprang up anew. But the ship continued locked hard and fast in the ice.

On July 30, three members of the Expedition ventured on a march over the icefield, with a view to testing the winter-conditions and whether a distant journey southwards might not be humanly possible.

This small pioneering party was surprised by a break-up in the ice and soon saw themselves the sole denizens of a floating island, the dimensions of which were evermore contracting till at last it was reduced to a space barely sufficient for their encampment. It was only with the greatest difficulty that they succeeded in regaining the ship. A few days later, two sailors rashly left the ship in foggy weather and lost themselves. It was only next morning, during a brief clearing, that they again descried the *Belgica* and rejoined their vessel, after passing an inhospitable night on the ice, and giving to those they had left on board the experience of a night of cruel anxiety.

January 1899 found the *Belgica* still shackled fast with icy chains. Yet in the distance fields of ice were seen separating, and huge icebergs shifting position, an indication of a general movement in the pack. To break the icefield in which the ship lay locked, heavy charges of tonite were exploded. The ice was not so much as broached by the powerful explosive. A hundredweight of tonite made no impression. It only scooped out a sort of funnel, some thirty feet in radius. The ice showed no break, no hole.

The Expedition then attempted to cut a canal from the ship's bows to a basin of open water. The ice however here proved too thick and the experiment had soon to be given up. A series of soundings having then been made, the edges of a canal were traced along the line of thinnest ice, from the ship's stern to a clearing 2,500 feet distant. The Expedition to a man all buckled to the task and for one long month worked at it like navvies day and night. At the moment when the work was nearing completion a pressure of ice set in and partially closed the canal. In the teeth of this disappointment the heavy labour was resumed. Happily, this time it was crowned with hard-won success. The ship was delivered from her bonds and guided into the open water.

The Belgica then made headway northwards, but was soon again brought to a stand-still. A short distance from the edge of the pack she was anew held fast for a whole month. There the swell of the sea hurled enormous floes against the ship's ribs, threatening to batter it in pieces.

On March 14, 1895, the ice again yielded and the Belgica threaded her way between icebergs and floes. That evening, having at last cleared every impediment, she put out into the open and headed straight for South America. The Belgian Expedition had been imprisoned, in all thirteen months, in the pack-ice, drifting with the ice at the will of the tempests.

THE DRIFT

Whoever casts a glance at the ship's route during the drift will see how tortuous it was. For a considerable while the *Belgica* is first fixed in one spot; then retreats to the north; then, March 15, 1898, veers back in a SW direction; eight days later turns her head anew to the north, pushing slightly beyond her latitude of March 15; then resumes and continues a SW course till April 21. She then seems to have reached the extreme west point of her programme, and therefore made a bend thence to the NE. On May 4, she drifts again southwards to the position she had occupied on March 23. From May 4 to June 22, the ship is borne away ENE; then, from June 23 to July 9, WSW. Thereafter till August 20, she makes a NE course. From August 20 what movement she makes is extremely slow, and her immobility becomes most pronounced from 3 to 16 September. After that date and till October 7 she drifts southwards. Then, after again making twenty miles to the north, she turns to the NE, and proceeds to fix herself from October 19 to March 5 in a quarter close to where, by the edge of the icefield, she had penetrated on February 21, 1898. Next from 5 to 25 November the ship held a SW course, then till December 12 a NNE. Thereafter she headed SW, till, on December 27, she turned NNE. and kept that course

up to January 4, 1899. From that latter date till January 31 she was rapidly borne away in a SW direction. Thereafter till February 19 she pursued a still more rapid course westwards. From the latter date till March 14, the drift continued westwards, yet with a slight inclination to the north, with accelerating pace. It was on March 14, that the *Belgica* managed to clear herself of the ice.

The following are the most noteworthy facts in connection with the drift : —

As long as the ship was to the E of Peter I Island, the easterly winds blew the ice south-westwards, and the drift was fairly gentle. It looked as though an accumulation of ice, arrested on its way by Peter I Island, diverted a part of the icefield southwards. When, contrariwise, the ship was to the west of Peter I Island, the ice, having full scope towards the west, drifted westwards so long as the wind was blowing east.

There was even a slight inclination to the north observable, a leaning which might be due to the impulsion of ice descending from the antarctic continent. Similarly, the westerly winds do not drive the vessel eastwards. The icefield is carried rather in a NE direction. This fact may be accounted for by the impulsion of the ice coming from the region of the Antarctica in the neighbourhood of Alexander I Land. Finally, the vicinity of this land and the enormous accumulation of ice barring all access to it may explain why the ship became nearly stationary each time she approached Alexander Land.

METEOROLOGY

During the wintering of the Belgica in the Antarctic ice, meteorological observations went on hour by hour. Besides these hourly observations, the clouds, snow, hoar-frost, austral auroras and the optical phenomena of the atmosphere were studied systematically and continuously. The lowest barometric register was note l on March 2, 1899, and was 711.7 mm. The highest atmospheric pressure was observed on June 11, 1898, and was 772.1 mm. The mean of all the observations was 744.4 mm.

The following table gives the principal thermometric results :

1898-1899.	TEMPERATURES (Centigrade).		
	MAXIMA.	MINIMA.	MEAN.
March	- 0.6°	- 20.3°	- 8.9°
April.	- 0.6	- 26.5	- 11.8
May	+ 0.8	- 25.2	- 6.5
June	0.0	- 31.2	- 15.5
July	- 1.1	- 37.1	- 23.7
August	+ 0.3	- 29.8	- 11.3
September	+ 0.9	- 43.1	- 18.6
October	+ 0.8	- 26.3	- 7.8
November	+ 1.0	- 21.4	- 6.9
December	+ 2.5	- 14.8	- 2.3
January	+ 1.8	- 8.4	- 1.2
February	+ 1.1	- 9.8	- 1.1
Maximum temperature of the year . . . = + 2.5°, 27 th December.			
Minimum — — — = - 43.1°, 8 th September.			
Mean — — — = - 9.6°			

The climate of the Antarctic regions is not only severer — and especially in the summer months — than that of the Arctic regions, but is also much more uncomfortable from the great frequency of storms, abundance of atmospheric precipitations, the great number of foggy and cloudy days, and in general from the excessive changeableness of the weather.

Thus the number of snowy days for the whole year amounted to 260, while there were only 20 days on which a little rain fell. The number of days without a break in the clouds amounted to 82, or 22 p. c. for the year, and the number of hours during which the sky was entirely overcast amounted to 62 p. c., while the number of hours of serene sky formed but 10 p. c., of the hours of observation. Moreover, during 261 days (or 72 p. c.) fog was registered.

The Meteorological Reports of the Belgian Antarctic Expedition give a detailed account of the observations made on board the *Belgica*.

OCEANOGRAPHY

The wintering of the *Belgica* in South-Polar ice was not to the advantage of oceanic research. Imprisonment in the pack necessarily limited investigation to the comparatively narrow field of the drift. By way of compensation, however, the soundings made by the *Belgica* followed one another at so much the briefer

intervals, while the thermometrical measurements and measurements of density of water were also pursued with as much frequency as circumstances permitted. The oceanic data accumulated by the Belgian Expedition are, therefore, within the limited range to which they were confined, so much the more complete. The line of soundings executed between Staten Island and the South Shetlands shows that the lands of Cape Horn are separated from the Antarctic by a flat bottomed basin rising with gentle slope towards the south. A maximum depth of 13,250 feet ($2\frac{1}{2}$ miles) was obtained at the foot of the continental plateau of the Andes. The thermic conditions of this great antarctic channel, uniting the Pacific with the South Atlantic Ocean, are similar to those found by the Challenger Expedition, in its time, in the south of the Indian Ocean. A sounding made in the middle of Gerlache Strait gave a depth of 2,050 feet. The numerous soundings made south of the Antarctic Circle on the voyage of exploration along the edge of the pack, and later during the drift in the ice, prove the presence of a continental plateau, extending from the SW of Alexander Land to beyond 100° W long. — a continental plateau rising towards the south and terminating on the side of the Pacific Ocean in an abrupt declivity. The termination of the continental plateau is approximately indicated by the isobath of 2,000 feet. The minimum depth, obtained at 71° 35', was found to be 1,280 feet. The presence of a coast extending to the

west in the vicinity of the region of the drift of the Belgica is therefore highly probable.

The sediments of the Antarctic Seas are terrigenous. The continental plateau is strewn with pebbles shipped and dropped by the icebergs. The petrographic study of these erratics, drawn up from the ocean-floor, demonstrates a great variety of rocks. Gravel and sand were found mixed with argillaceous sediments containing likewise a certain proportion (sometimes considerable) of remains of calcareous organisms, especially globigerinae. These facts prove the inaccuracy of the maps showing the distribution of marine sediments, wherein, on the basis of evidently insufficient data, is exhibited a vast area of diatomaceous ooze all round the South Pole.

Thermometrical measurements showed that the thickness of the frozen waters (having a temperature below 0° C.) increases with the progress southwards. In the ice the coldest water (-2° C.) is found near the surface; towards the bottom the water has a temperature slightly above 0° C. The density and salinity of the water increases with the depth. When there is no ice in fusion — a state in which the salinity of the water diminishes — the chlorination is confined to between 18 and 19 per 1,000 parts.

The formation of sea-ice and the rate at which its thickness increased were studied during the wintering of the Belgica. All the transformations, moreover,

undergone by the ice in the course of the drift were uninterruptedly registered. The mutual pressure exerted by the floes has also been repeatedly described and photographed. The Expedition has accordingly brought home important materials for the study of glaciation.

FAUNA AND FLORA

The zoological service of the Expedition was strenuously pursued with pelagic nets and all the appliances for deep-sea fishing. Shoals of plankton, swimming at the surface, were caught, but the number of species proved to be small compared with the number of individuals. Thus, to take only the Copepods, represented in so great variety among the planktons of the temperate seas, no more than 24 species, all new, of these little Crustaceans were found. Pelagic Algae were very abundant, especially just under the surface and on the immersed walls of the ice. In these regions of the Earth, they are represented especially by the *Diatomaceae* (particularly *Chaetocera*, *Coscinodiscus* and *Chorethron*). They constitute veritable sea-prairies, sustaining, directly or indirectly, the life of all the creatures in the antarctic seas.

The bottom-sea fauna, confined to a continental plateau not dipping below the level of 1,000 to 1,600 feet, is at once more varied and interesting. Notwithstanding the slight depth of its habitat, the fauna exhibits a purely abyssal character. The species, so far as yet studied, are

all new, and many of them presented generic types that had hitherto never been described. The abysmal character of this fauna is to be accounted for by the low temperature of the water it inhabits.

The Seals found by the Expedition on the antarctic icefield comprised four species : the Crab-eating and the Weddell seals, already mentioned among the animals discovered in Gerlache Strait; the Ross's seal and the Sea-leopard.

Ross's seal (*Ommatophoca rossii*) was met with only in summer, and in all only thirteen were counted. It differs structurally from other species by the excessively small proportions to which its limbs are reduced and by a peculiar vocal faculty which it owes to the possession of resonant sacs with which no other seal is endowed.

The Sea-leopard (*Ogmorhynchus leptonyx*) is more than ten feet long. It moves about nimbly on the ice, and will, so it appears, attack Penguins. This latter fact was not verified by the Expedition, but M. Racovitza witnessed two Sea-leopards disputing possession of the carcass of a Penguin that had been thrown overboard.

When a seal has been cut up, its carcase, abandoned on the icefield, attracts to it the giant Petrels — the grand knackers of the cold regions. Under the sting of hunger they dash down on the body and plunge neck-deep into the riven flesh. The snowy and the antarctic Petrel were a habitual appearance all the year round.

Two species of penguins were found : the Adelia

Penguin (*Pygoscelis Adeliae*) and the Forster or Emperor Penguin (*Aptenodytes Forsteri*). The first of these two is very much like the Stone-cracker Penguin of Gerlache Strait, but the sides of its head are black and its neck black or white.

The Emperor penguin measures more than a metre in height and may attain a weight of over 88 lbs. Its head is black on the top, and of a magnificent golden yellow on the sides. Its bill is long and generally black, all but the base where it is streaked with purple and blue. The eye is small, and images absolute imperturbability. The breast and abdomen are snow-white in contrast with the back which is dark blue dashed with a reflection of gray. Round its neck is a ring of white feathers.

Rorquals (*Balaenoptera*) and Bottle noses (*Hyperoodons*) were of frequent occurrence.

SUMMARY RESULTS OF THE EXPEDITION

The Belgian Expedition did not take for its goal the attainment of a high latitude. Its mission it construed to be that of investigating with all zeal and fidelity some corner of the vast antarctic region, a region the preliminary reconnaissance of which had been the adventurous task of a Cook, a Bellingshausen, a Biscoe, a Dumont d'Urville, a Balleny, a Wilkes, a Ross and others.

Geographically, the region of the Expedition's investigation lies to the north of Graham Land. There the

Expedition has opened to Geography a spacious strait, Gerlache Strait. The coasts of this Strait, on which twenty landings were effected, have been industriously surveyed. Nor is the discovery of this Strait to be rated as a mere geographical datum of no practical importance. It will in future afford a safe shelter to ships driven by tempest as far as the South Shetlands. In the Strait there will perhaps spring up also a profitable fishery, for Balaenoptera and Megaptera are there in great abundance.

The Expedition has further demonstrated the existence of a continental plateau spread over more than thirty degrees of longitude, a fact furnishing one of the weightiest arguments in favour of the continental view of the Antarctic.

We may here call to mind that had the international missions of 1882 known of the island of Cavelier de Cuverville, one of them would in all likelihood have planted itself there with advantage.

During the drift, the Expedition was carried away to the south of Peter I Island. This island may therefore be assumed to be either isolated or to form part of a very small archipelago. The Belgica navigated over the place where Walker believed he had seen land, and also over the place where Bellingshausen believed he had seen the wall of ice.

Oceanographically, the Expedition has brought home lines of bathymetric measurements and important data

respecting the sea-floor and submarine temperatures, and numerous measurements of densities of sea-water.

Geology has gathered a rich store of specimens and important information on glaciers.

Astronomy and magnetism have been the objects of studious observations on the part of the scientific staff. Curves bearing on terrestrial magnetism have been traced with precision, curves which for this region were drawn hypothetically.

Meteorology has been enriched with observations made for the first time in these regions hour by hour throughout the period of a whole year. The Austral auroræ, optical phenomena of the atmosphere, clouds, snow and hoar-frost have been studied in a consecutive manner.

The marine and terrestrial fauna had never yet been studied save at South Georgia. All that was known of the plants of the Antarctic lands, properly so called, comprised but nineteen species brought home by Ross's Expedition.

The catalogues of the Belgian Antarctic Expedition include 1,200 animals and about 500 plants, representing a much larger number of specimens.

For the first time, the terrestrial flora of the Antarctic has been satisfactorily studied; 55 species of Lichens and, in place of the three formerly known, 27 species of Moss have been collected.

Several new species of fresh-water Algae, three of

Liverworts (*Hepaticae*), one species of Grass, and the *Sclerotikum antarcticum* — a new Mushroom — are to be added to the list of botanical finds.

The land and fresh-water animals specified on pages 22 and 23, constitute the first contribution to the study of the terrestrial fauna of the antarctic regions properly so called.

It is for the first time also that the marine fauna, both bottom-sea and surface, has been harvested for science from the other side of the Antarctic Circle. The studies already published on a part of these finds attest what high interest they have, as well from a morphological point of view, seeing that almost all the species are new, as from a biogeographical point of view.

The reproduction and development of Seals is a subject hitherto unknown to science. This so interesting group of Mammals has never yet been studied from this point of view, in its Arctic any more than in its Antarctic representatives. The beautiful series of embryos and foetuses acquired by the Belgica is therefore a material doubly precious. The Antarctic Seals have, moreover, been carefully studied in their habits, and for the first time it will be possible to set forth their biology in detail.

Of like profit will be the labours of the Expedition in respect of the study of Birds, both such as inhabit the ice-fields and such as inhabit the lands visited by the Belgica.

A series of minute observations, illustrated by nume-

rous photographs, has cleared up a number of points in the life and behaviour of the Cetacea. It will therefore now be possible to distinguish the different species by their respective external appearances and their habits. The memoir devoted to these animals establishes also a fact of importance from a practical point of view, namely that Right Whales are not to be found on the other side of the Polar Circle.

Finally, the Belgica is the first ship to have wintered in the Antarctic. This wintering experience was all the more fortunate inasmuch as it was made in a quarter of more than common interest as a field of study, that very quarter which the English had chosen for the wintering of their last Antarctic Expedition commanded by Scott, an Expedition which set out for the South Polar regions a year after the return of the Belgian Expedition.

But, apart from these scientific results, the Belgian Expedition may be said to have been of happy influence morally for Belgium. It has widened the horizon of active interest to the people of Belgium who had hitherto confined their efforts to the, doubtless, gigantic, but yet isolated, task of the colonisation of the Congo. The Belgians have shown that if their factories are filled to overflowing with orders returning them a plenitude of wealth, if they know how to organise expeditions of commercial exploration from which they draw piles of gold, they are likewise capable of working disin-

terestedly in order to pay unstintedly the tribute due of them to Science.

But it was not enough to have amassed a great body of records and rich scientific collections. It was further necessary to make them available. With a largeness of view one cannot help admiring, M. de Trooz, Minister of the Interior and Education, addressed a special report to the King, pointing out of how great service it would be to give public value to our scientific stores, and presenting for the royal sanction a resolution appointing the Commission of the Belgica.

This Commission is composed of the members of the Scientific Staff of the Belgica and the members of the Royal Academy of Belgium who had specially devoted themselves to the success of the Expedition. It had for its president Lieut.-General Brialmont.

Lastly, eighty men of science, including both Belgians and foreigners, were chosen to study the collections and render them publicly available. They are at present actively engaged in this work.

THE BELGICA COMMISSION

President.

Professor VAN BENEDEN, Member of the Royal Academy of Belgium. (Appointed President, 21st August 1903, in succession to the late Lieutenant-General Brialmont.)

Vice-President.

M. A. DE GERLACHE de Gomery, Keeper of the Royal Museum of Natural History, Commander of the Belgian Antarctic Expedition.

Secretary.

M. G. LECOINTE, Scientific Director of the astronomical service of the Royal Observatory of Belgium, Executive Officer and Hydrographer of the Expedition.

Members.

MM. HENRYK ARCTOWSKI, Geologist, Oceanographer and Meteorologist to the Expedition.

Dr. FREDERICK A. COOK, Surgeon and Anthropologist to the Expedition.

ANTOINE DOBROWOLSKI, Assistant Meteorologist to the Expedition.

EMILE-G. RACOVITZA, Assistant Director of the Arago Laboratory of Banyuls s/mer (annex of the Sorbonne of Paris); Naturalist to the Expedition.

MM. Lieut.-General DONNY, King's Aide-de-camp, Inspector-General of Artillery.

DUFIEF, Secretary to the Belgian Royal Geographical Society to Brussels.

DUPONT, Director of the Royal Museum of Natural History, Member of the Royal Academy of Belgium.

DURAND, Director of the Belgian Botanical Gardens.

Professor LÉO ERRERA, Member of the Royal Academy of Belgium.

Professor CHARLES LAGRANGE, Honorary Director of the Royal Observatory, Member of the Royal Academy of Belgium.

LANCASTER, Scientific Director of the meteorological service of the Royal Observatory of Belgium, Member of the Royal Academy of Belgium.

PELSENEER, Member of the Royal Academy of Belgium.

Professor SPRING, Member of the Royal Academy of Belgium.

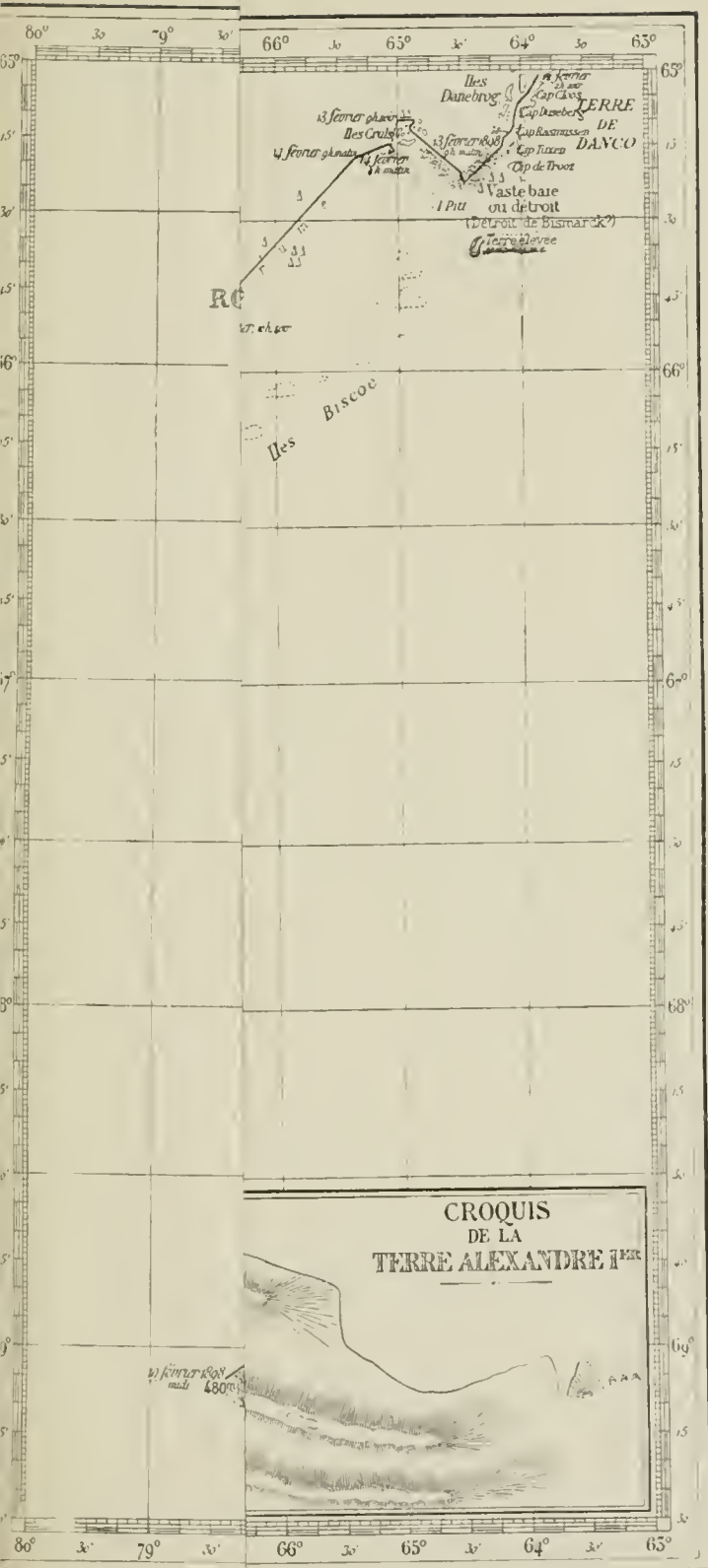
Professor STAINIER.

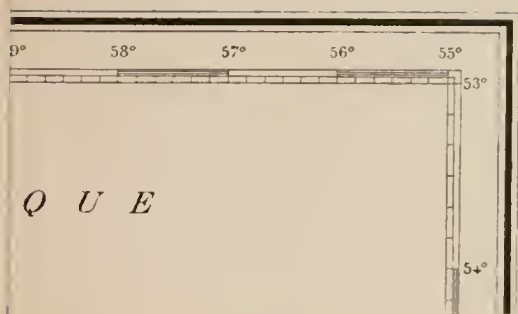
DÉTROIT, DE BRANSFIELD

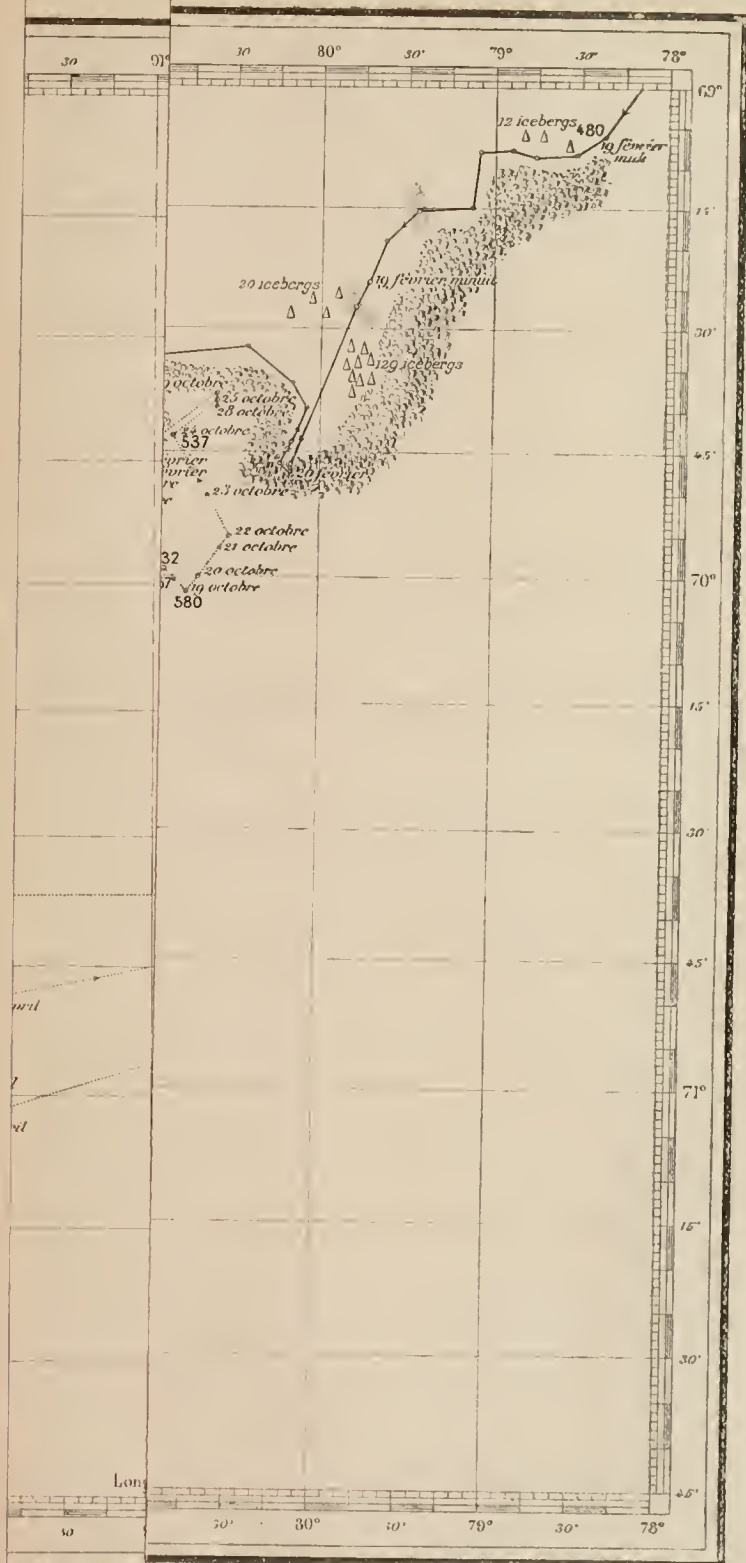
LEGENDE

- Route 101
Cinquante et une
12 Février 1953
Montagne de 1200 mètres
troupe
Sous le glacier
Rouge









Fritz Menger del.

LIST OF SCIENTIFIC REPORTS

PUBLISHED UNDER THE DIRECTION OF THE

Belgica Commission.

The memoirs the titles of which are preceded by an asterisk have already appeared, or are about to appear. Classification of the reports in vols. III to IX will be made in the near future.

VOL. I

Relation du voyage et Résumé des résultats, by A. de GERLACHE DE GOMERY.

**Travaux hydrographiques et Instructions nautiques*, by G. LECOINTE

Note relative à l'usage des explosifs sur la banquise, by G. LECOINTE.

VOL. II

ASTRONOMY AND MAGNETISM

**Étude des chronomètres* (deux parties), by G. LECOINTE.

Recherche des positions du navire pendant la dérive, by G. LECOINTE.

Observations magnétiques, by CH. LAGRANGE and G. LECOINTE.

Note relative aux mesures pendulaires, by G. LECOINTE.

Conclusions générales sur les observations astronomiques et magnétiques, by GUYOU.

VOLS. III-IV

METEOROLOGY

**Rapport sur les observations météorologiques horaires*, by H. ARCTOWSKI.

**Observations des nuages*, by A. DOBROWOLSKI.

**La neige et le givre*, by A. DOBROWOLSKI.

**Phénomènes optiques de l'atmosphère*, by H. ARCTOWSKI.

**Aurores australes*, by H. ARCTOWSKI.

Discussion des résultats météorologiques, by A. LANCASTER.

VOL. V

OCEANOGRAPHY AND GEOLOGY

Rapport sur les Sondages et les Fonds marins recueillis, by
H. ARCTOWSKI and A. F. RENARD.

Rapport sur les Relations thermiques de l'océan, by H. ARCTOWSKI and H. R. MILL.

**Détermination de la Densité de l'eau de mer*, by J. THOULET.

**Rapport sur la Densité de l'eau de mer*, by H. ARCTOWSKI
and J. THOULET.

Note sur la couleur des eaux océaniques, by H. ARCTOWSKI.

*Les glaces antarctiques (Journal d'observations relatives aux
icebergs et à la banquise)*, by H. ARCTOWSKI.

Note relative à la géographie physique des terres antarctiques,
by H. ARCTOWSKI.

La géologie des terres antarctiques, by A. F. RENARD.

Note sur quelques plantes fossiles des terres magellaniques,
by M. GILKINET.

VOLS. VI-IX

BOTANY AND ZOOLOGY

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Diatomées (moins Chaetocères), by H. VAN HEURCK.

Péridiniens et Chaetocères, by FR. SCHÜTT.

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**Mousses*, by J. CARDOT.

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**Madréporaires*, by E. v. MARENZELLER.

**Hydrocoralliaires*, by E. v. MARENZELLER.

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Méduses, by L. SCHULTZE.

Alcyonaires, by TH. STUDER.

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Nématodes parasites, by J. GUIART.

Chaetognathes, by O. STEINHAUS.

Géphyriens, by W. SPENGEL.

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M^{me} BOMMER, Brussels.

MM. BOMMER, CH., Assistant in charge of the Botanical Gardens, Brussels, Professor in the Free University, Brussels.

BOVIE, A., Brussels.

BRACHET, Demonstrator of Anatomy in the University of Liege, Liege.

CERFONTAINE, P., Demonstrator of Zoology in the Zoological Institute of Liege, Liege.

DE WILDEMAN, E., Assistant at the Botanical Gardens of Brussels, Brussels.

DOLLO, L., Keeper of the Royal Museum of Natural History, Professor in the Free University, Brussels.

SEVERIN, Keeper of Museum of Natural History, Brussels.

GILKINET, Professor in the University of Liege, Liège.

JACOBS, J.-C., M. D., Brussels.

KEMNA, AD., Antwerp.

LAMEERE, A., Professor of Zoology in the Free University of Brussels, Brussels.

LEBOUCQ, Professor of Anatomy in the University of Ghent, Ghent.

M^{me} ROUSSEAU, Brussels.

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TOSQUINET, J., Ex-Army Sanitary Inspector, Brussels.
(Died.)

VAN DEN BROECK, E., Keeper of the Royal Museum of
Natural History, Brussels.

VAN HEURCK, H., Director of the Botanical Gardens of
Antwerp, Antwerp.

WILLEM, V., Demonstrator of Zoology in the University of
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sity of Kiel.

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CHUN, Prof. Dr. C., Professor of Zoology in the University
of Leipzig, Leipzig.

DREYER, F., Assistant in the Zoological Institute of Jena,
Jena.

HARTLAUB, Prof. Dr. C., Curator of the Biological Station
of Heligoland.

LUDWIG, Prof. Dr. H., Professor of Zoology and Com-
parative Anatomy in the University of Bonn, Bonn.

MÜLLER, Prof. Dr. G. W., Professor of Zoology in the
University of Greifswald, Greifswald.

PFEFFER, Prof. Dr. G., Curator of Zoology in the Hamburg
Museum of Natural History, Hamburg.

PLATE, Tit. Prof. Dr. L., Priv.-Docent of Zoology in the
University of Berlin, Berlin.

SCHULTZE, Dr. L., Privat-Docent of Zoology in the Univer-
sity of Jena.

SCHÜTT, Prof. Dr. F., Professor of Botany in the Univer-
sity of Greifswald, Director of the Museum and of the
Botanical Gardens, Greifswald.

SPENGEL, Prof. Dr. J. W., Professor of Zoology in the
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- OLIVIER, E., Moulins.
- PORTIER, P., Demonstrator of Physiology at the Sorbonne and in the Institute of Agronomy, Paris.
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